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Electrical Review.

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LEGISLATION FOR CABLE PROPERTY.

WE have already in a previous number placed before our readers some of the dangers and mishaps to which cables are liable, not only when resting on the ocean bed, but likewise when laying or repairing operations are being conducted. At that time we also touched more particularly on the subject of delays in cable repairing occasioned by the non-exemption of cable ships from custom house formalities and from quarantine regulations.

We now propose to consider with some details the subject of drift fishing operations, which should not at all be confounded with those of trawling.

In order to thoroughly understand these operations, as carried on in the North Sea, we may give the following information, which perhaps will be interesting as bearing more or less directly on the question of legislation for cables. Whilst drift fishing, the fishermen at different seasons of the year change their ground. During July and August they are to be found off the north of England, when they include amongst them the fishermen of all nationalities. Towards the end of September, and until the middle of December, the fishing is carried on off Lowestoft and Yarmouth by English and Scotch fishermen. After Christmas, fishing is carried on along the Flemish banks, and the French fishermen at that time work off Cape Grisnez; some fishing however is done near the North Foreland by the English fishermen. The Dutch fishermen during this time carry on their work in home waters. This finishes the herring drift net season.

In January, towards the end of the month, mackerel fishing is carried on off Yarmouth and Lowestoft, and round the south coast of England. In the waters off Lowestoft there have been at one time as many as 550 English fishermen, 150 Scotch fishermen, and 70 Dutch fishermen, besides a few of other nations.

The English fishermen generally fish about 30 miles from land. Their craft are from 50 to 60 tons, and carry sprit sails, dandy-rigged, and have on board about 18 men. The Scotch fish about 8 miles from shore in small open boats, while the Dutch have large boats of 50 to 60 tons, and carry a crew of about 40 men. Their work is carried on principally at distances from the land varying from 40 to 50 miles. The French carry 20 men, and have slightly larger craft; the rig being a double lug sail. The Belgians are nearly all trawlers, and these do considerable damage to the cables, as described by Mr. Erichsen in his letter recently forwarded to the Government. The Dutch never fish on Sunday and they generally anchor their boats on the fishing ground in, say, 20 fathoms, and as the rope they use as a cable and the anchor are very light, they do not get a good hold of the ground and drag, until they bring up on a cable; in other words, they go through the same operations as a cable-repairing ship when grappling. But to resume the question of drift net fishing, no fishermen fish inside of 8 miles, as they wish to avoid the steam traffic up and down the coast and the danger of their nets fouling the buoys placed by the Trinity Board to mark the different shoals.

In drift net fishing a net is used in length of about 1½ miles; this net carries a top rope about 4½ inches in circumference, and is 10 feet wide. It is suspended to floats or bladders by short pieces of rope; the length of these pieces is generally 2 fathoms, but this length is varied according to the lie of the fish. The French fishermen use a slightly heavier top rope.

Each boat shoots, as it is called, his net across the tide; the shooting consisting in paying away the net about slack water, if possible, and sailing the craft slowly across the tide; the slack water is not however an absolute necessity.

Fishing is generally carried on between sunset and sunrise, but sometimes the nets are left out all day. The drift on one tide is generally from 10 to 15 miles over ground, according to the tide's strength; the nets are sometimes left overboard for the return tide, if they are not already heavy with fish. Moonlight of course is preferred for these fishing operations. Fishing fleets within a radius of 5 miles will sometimes number from 50 to 70 vessels. When thus fishing in fleets, the shooting is done by each boat allowing ½ mile between it and its next neighbour, so that they do not often foul each other. If a fleet is drifting with the tide it is possible, owing to the nets of the different boats overlapping each other, to cover ground amounting to 20 miles in width. Now, as it takes from 4 to 5 hours for the crews to gather their nets in, it will be understood how difficult it is for the fishermen to clear buoys, of which the position is unknown to them, when fishing in the night time as is usually the case, and when generally the buoys cannot be seen until the nets are fairly on the top of them.

As Mr. J. R. France (who was formerly engineer to the Submarine Telegraph Co.) wrote to the *Times*, on Nov. 19th, "I have been fouled with 5 drifts of nets at one time, sweeping away both buoys and steamer." We can readily understand the strain of five drifts of nets, each net 1½ miles long, being irresistible, and carrying away even the repairing steamer from her anchorage. This particular case is inexcusable, as the steamer carries lights which would probably be visible at a distance of from 5 to 6 miles.

The only practicable way of avoiding the difficulty of fishermen interfering with cable repairs is, that the repairing steamer should as far as possible lie by the buoys, and pick up and relay the buoy which became endangered by the drift nets; and the only necessary agreement to be come to with drift fishermen is one for mutual advantage and convenience. For the fishermen have their nets damaged and sometimes lose them altogether, whilst the repairing steamer also risks losing its buoys.

This question of drift fishermen has, it is hardly necessary to say, nothing at all to do with our suggestion, as given in our leader of the 15th ult.; that suggestion referred principally to avoidable dangers of which the trawlers and those fishermen who anchor near the lines of cable are the cause. It would be unfair to expect a drift fisherman, whose nets are never near the ground, and consequently do no damage to the cables, to be held responsible for the carrying away of

buoys, the position of which must be manifestly unknown to him.

A contemporary, the mouthpiece of one section of the telegraph companies, in a recently published article, comments on our suggestions as to the rights of "first comers," and asks, "Who are the first comers to whom compensation should be paid?" Seeing that the most definite statements had been made in the article containing the said suggestion we are a little amused at the query, but as we would wish to make it clear even to those who perhaps wish not to comprehend our meaning, we will oblige by giving an instance as to who are "first comers." The English Government and the Eastern, the Direct Spanish, the Pouyer-Quertier, the Submarine, and the Great Northern Telegraph Companies would all be considered "first comers" in respect to the new line about to be laid from Valentia to Greetsiel, and according to our way of thinking each should receive its proportion of an indemnity to be paid by the new Company on account of its cable crossing, and therefore depreciating the value of, nineteen other cables.

We find that our article of December 15th has received considerable attention abroad, and the questions therein discussed have been taken up by *l'Electricien* of the 15th inst., by *l'Electricité*, and also by the Spanish papers. Likewise we are informed that the French Government is about to convene in Paris a diplomatic conference for the purpose of furthering international cable legislation.

To make the information on this subject as complete as may be necessary, we herewith reprint Mr. Erichsen's letter above alluded to, and also give a translation from *La Ville de Paris* of the 14th inst.

Translation from *La Ville de Paris* of 14th Jan., 1882.

It is well known that on account of the constant danger to which their cables have been exposed, the English submarine telegraph companies have made representations to the Board of Trade, asking them to interfere and to remove, if possible, the causes of these dangers.

The reply from the Board of Trade was that Her Majesty's Government would more fully investigate the matter, and see what could be done to remedy the grievances; but the Board added that in order to come to a definite understanding, international legislation would be necessary.

M. W. de Fonvielle, principal editor of *l'Electricité*, and who raised this question in France more than a year ago, in a letter to M. Barthélemy-St.-Hilaire, has since written to M. Gambetta, now the Minister for Foreign Affairs, and has drawn his attention to the necessity of taking immediate action.

M. Spuller replies officially to this letter that the Under-Secretary of State for Foreign Affairs has the question under consideration, and that M. Cochéry, Minister of Posts and Telegraphs, has forwarded to the ministry of foreign affairs copies of the resolutions come to at the Congress of Electricians.

M. Gambetta has come to an understanding with his colleague, and intends forwarding invitations to all the maritime nations to send representatives to an international congress. At this congress, which will shortly be opened, the whole subject of legislation for cable property will be discussed.

MR. ERICHSEN'S LETTER.

"SIR,—For a number of years the telegraph cables submerged in the North Sea have been exposed to great dangers in consequence of the fisheries carried on in those waters. This danger has increased to such an extent after the general introduction of trawl-fishing that it would be most desirable if the matter could be brought under the notice of the International Fisheries Congress now assembled at the Hague, in order that regulations for the protection of the cables may be agreed to by the different Governments. The damage done by the fishing boats is twofold, that caused by anchors and that caused by trawls. The former may be easily averted if the exact position of the cables became more generally known to the fishermen, and this being so there would also be very little difficulty in preventing injury by the trawls, particularly if a proper shape of the same were also adopted, and if it were made compulsory *that the trawls were always kept in proper repair*. The crossing of a cable, or the scraping along a cable of a heavy apparatus like the trawl must in itself be injurious to the same; but the danger is greatly increased when, after the wearing out of the bottom of the trawl, imperfect repairs are effected, as no cable can withstand the action of bolt-heads (not counter-sunk) and sharp projecting edges of clumsily-attached pieces of iron.

"Considering this present state of things it would therefore be very desirable—

"1. That fishermen were warned as far as possible to avoid anchoring or trawling in places where cables are laid. For this purpose the different Governments might issue charts showing the exact position of the cables, and the different men-of-war which periodically supervise the fishing operations might render valuable assistance in this respect.

"2. That distinct rules were laid down as to the shape of the trawls, and that it were made unlawful to alter the same by subsequent repairs, the due compliance with these rules being secured partially through the above-mentioned supervision by the men-of-war, partially through the inspectors of fisheries stationed at the ports of issue in the different countries. Any infringement of these rules ought to be punished with heavy fines.

"3. That rules were laid down for the guidance of the fishermen how to act in cases where they got foul of a cable, the telegraph administrations concerned agreeing to compensate the owners of the fishing boats for any anchors or fishing gear which might be lost in their attempts to get clear of the cable without injuring the same on production of satisfactory evidence. Wilful damage ought to be made punishable by heavy fines, or, eventually, imprisonment.

"4. That it were made compulsory for all fishing boats to carry a copy of the above charts, together with a copy of the International Rules which may be adopted.

"If these or similar rules were adopted by the Governments represented at the Congress, protection, as far as possible, would be given to the owners of telegraph cables and the public, who are more or less dependent upon the efficient working of the same, and at the same time the owners of fishing boats would also be protected. As to their cost, they must know that the crossing of a partly damaged cable means loss or serious injury to their nets. Considering that your department, as owners of many of the North Sea cables, is vastly interested in this matter, I have ventured to bring the same under your notice, and as verbally explained I hope that your department will see the desirability of taking the initiative at the Hague Congress with regard to this question, and to support measures in the same direction which may be proposed by other governments who are more or less interested in the protection of the telegraph cables in the North Sea.

"Finally, I beg leave to observe that as the sittings of the Congress have already commenced it would be very desirable, if convenient, that instructions might be sent out without delay to the British representative at the Hague Congress."

UNSCIENTIFIC JOURNALISM AND THE ELECTRIC LIGHT.

As a rule, if information on any particular subject is required by the general public, it is sought for in the pages of some periodical which is devoted to the particular object wanted, and the matter emanating from the articles in such journals is generally very carefully considered so that nothing fallacious and misleading shall be spread abroad, the amount of misconception to the public being of course in proportion

to the circulation of the paper. However, some periodicals are inclined to treat upon any subject that may at the moment be uppermost in the public mind, knowing that although their statements may be entirely without foundation and in almost every point misleading, the general public cannot refute what is set forth in their pages.

It is by such means as this that so much doubt is cast upon any subject of importance to the people, and probably no great enterprise has been more ignorantly dilated upon by the daily and quasi-scientific press than that of Electric Lighting.

As an example of such reckless misstatements, we extract the following from a contemporary weekly issue of the 7th January, which shall be nameless, and which constitutes part of an article written in reply to inquiries respecting the cost of fitting up an installation of the electric light :—

"The public are now satisfied that the electric light is superior to gas, not only in the quality of light, but also on the score of cleanliness and health ; but certain rumours as to the cost of the same cause business men to pause and consider this serious obstacle before they invest their money in the new system of lighting. Inquiries from gentlemen wishing to illuminate their mansions, owners of factories desiring to improve the lighting of their workshops, and tradesmen who want an improved light for their show-rooms, have been coming in from time to time, but to all of them we have been compelled to give a report concerning the estimated cost which has deterred them from proceeding to adopt the electric light in lieu of that from gas. Our latest application was from a gentleman who wished to light up his factory in the winter evenings with the incandescent electric light. In company with others, he had been to the Paris Exhibition, and had seen the various lights, and had come home filled with admiration of the Swan lamp and the Faure accumulator. We were asked to collect estimates of the cost for his guidance, and these we give here for the benefit of our readers. As he thought of introducing the light as an experiment into one department only at the commencement, our attention was first given to the maintenance of five lights with the current from a galvanic battery. The price quoted for the Swan lamps is £1 5s. per lamp, and the electromotive force necessary to work one lamp is put down at 50 volts per lamp, or the current from 30 half-gallon Bunsen or Grove cells connected in series. Estimating the cost of this battery to be not less than £10, we get the following result :—

5 Swan incandescent lamps, at 25s. per lamp ..	£6	5	0
5 Bunsen batteries of 30 cells, at £10 per battery	50	0	0
300 lb. nitric acid, at 7d. per lb.	8	15	0
150 lb. sulphuric acid, at 2d. per lb.	1	5	0
100 yards copper cable, about	2	0	0
Labour of fitting lamps, and attention (one night)	1	0	0
	£69	5	0

"It would cost this to start the five lamps. We have left out the cost of their maintenance, for when the proprietor saw that it would cost nearly as much to light one department with the electric light during one night as it would to light the whole factory with gas for one season he gave up the idea of maintaining the current with a galvanic battery, and bade us turn our attention to the Faure accumulator. Part of the factory was driven by water-power, and there was only enough water flowing by day to work that part ; but he could run the wheel at night, and store up electric power for the next evening's electric light. In this way he could afford to light up all the factory. We again plunged into figures, with the following result :—

180 Swan lamps, at 15s. per lamp	£135	0	0
18 batteries of 30 Faure cells, at £4 per cell ..	2,160	0	0
1 dynamo-electric machine	80	0	0
Cost of laying down, belting, pulleys, &c., about	5	0	0
Cost of fixing lamps, cables, switches, &c., about	20	0	0
	£2,400	0	0

"In giving the above figures, we are merely quoting from the vendors' price-lists, as published by them (taking advantage of the reduction allowed by vendors to large consumers), and have only ventured an estimate of the cost of other items, based on previous experience. The estimated number of Faure cells was given to us as thirty per ten Swan lamps for three hours."

We will take the electromotive force necessary to overcome the resistance in a Swan lamp, as stated by our contemporary, viz., 50 volts, although this is more than is needed, and the number of cells to give us that tension as 30. Now the internal resistance of such a cell as described and properly made cannot be more than 0·1 of an ohm. Let us take it at this figure, and the resistance of a Swan lamp when incandescent as 30 ohms. Each lamp requires a current strength of about 1·25 ampères to produce 10 candles. We will now arrange the 5 Swan lamps in a parallel circuit, which will give us an external resistance of 6 ohms, it being hardly necessary to add the very small resistance of the leads. The internal resistance of our battery will be 3 ohms, then by formula,

$$C = \frac{E}{R+r}, \text{ or } C = \frac{50}{6+3} = 5{\cdot}55 \text{ ampères,}$$

but as 30 Bunsen's or Grove's cells would actually give us an electromotive force of 54 volts, we have in reality 6 ampères of current flowing, which is just enough to keep our 5 lamps burning. Instead therefore of requiring for such a purpose 5 batteries of 30 cells each and costing £50, we only need one, which reduces the expense to one-fifth. The amount of acids will of course be reduced in proportion, and as for some time past the lamp itself has been reduced to 12s. 6d., we get for starting 5 lamps worked by a galvanic battery a first cost of about £18, as against £69 as stated in the pages we quote from. Had the writer been dealing with dynamo-machines he would probably have discovered his mistake, for had he made a similar comparison to the above it would read thus :—"The electromotive force used by Edison for each one of his lamps is about 100 volts, which he obtains from a single machine, therefore to work 1,300 Edison lamps we require 1,300 machines giving 100 volts each." It would be well when again trying to give data on such a subject to determine not only the electromotive force of the battery or machine mentioned, but also what current strength it can produce through a certain resistance. The electromotive force of 30 Grove's or Bunsen's cells is precisely the same whether the cells are each only the size of a tumbler and the electrodes as big as a sixpence, or as big as a gallon jar with electrodes a foot square.

The next item in regard to the Faure accumulator is equally fallacious. The writer states that he was informed that the number of Faure cells necessary to work 10 lamps is 30. Now the statement on the circular of the Faure Accumulator Company reads as follows :—"With 50 cells, 30 incandescent lamps burning in a vaccum, each of 10 to 12 candle-power, can be illuminated for 6 hours." Therefore 300 such cells would be ample to keep 180 Swan lamps working for the above-mentioned time. Our contemporary however gives nearly double this (540) as being requisite. Calculating from the figures given in the estimate this means a saving of £960 in cells alone. From tests of these accumulators which we recently received from an independent and thoroughly reliable source, we have each cell giving an electromotive force of 2·1 volts with an internal resistance of only ·005 ohms. If our contemporary will work out from this the effective work which can be produced it will be found that 30 Faure cells, giving an electromotive force of 63 volts and having resistance internal of ·15 ohms, produce sufficient current to keep not only 10 but 18 Swan lamps burning.

We need not go any further, as what we have already shown is sufficient to prove to those seeking information that it is necessary to be more cautious as to the sources to which they apply for the required knowledge. It may also make quasi-scientific periodicals more guarded against treating on a subject outside their special domain, or at any rate, if they find it at times advisable to remark upon general topics of scientific interest to at least study carefully what they have to say, keeping in mind that a certain statement in one journal and a contrary statement in another is the reason why the general public is continually swayed from side to side, not knowing what to believe. The electric light is quite expensive enough as it is without having fictitious prices attributed to it, for while many would be willing to spend, say, £1,000 on an installation, they would naturally hesitate if told by an apparently reliable authority that the cost would be twice or thrice that amount, and the many advantages attached to electric lighting would thereby be lost to them. It is such journalism as this which hinders the quick progress of the great results the electric light is eventually destined to achieve.

ROTARY PHOTOMETER.

(NAPOLI SYSTEM.)

WE know that with the various photometers now employed, if we except Arago's apparatus and some similar ones little used, it is necessary to arrange the luminous sources in such a manner that the light from one, thrown on to a screen, shall be apparently equal to that of the other thrown on to the same screen. The relative distances of the two lights from the screen give the ratio of the intensities, the weaker one being taken as the unit. Generally the spermaceti candle is taken as the standard for measuring lights of feeble intensity and the Carcel burner for more powerful lights. Various causes tend to render these instruments defective in their working.

(1.) The more distant light has to pass through a greater volume of air, and thus a loss of power is occasioned which cannot be taken into account.

(2.) The luminous rays from this more distant light are projected on to the screen at a smaller angle than that formed by the rays of the nearer light, and the eye which receives simultaneously the two effects, commits, if not well placed, an error which becomes the greater the more it departs from the bisection of the angle which the luminous rays make, the screen being taken as the vertex.

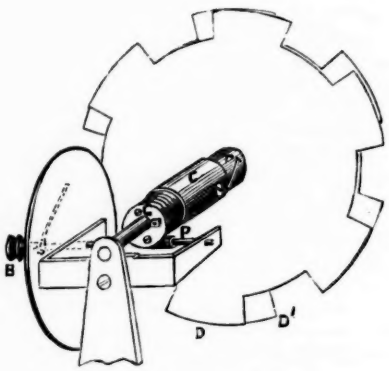


FIG. 1.

(3.) Instruments of this kind are troublesome to manipulate, &c.

The rotary photometer exhibited obviates these inconveniences to a great extent. It takes up little room, its regulation is simple, and its mode of action easy. It differs especially from other photometers in that the two luminous sources must be equally distant from the apparatus however far from it they may be placed.

The principle of the calculation of luminous intensities is based on the following phenomena :—

(A.) If through an opening in the wall of a dark room, the light emitted by any luminous source whatever be projected on to the opposite wall, the surface lighted up appears of uniform intensity all over, that is, on condition that the rays be as nearly parallel as possible. If we reduce this opening by half, the quantity received by the opposite side of the dark room will also be reduced by half; and this will hold good with any diminution whatever of the opening, the light projected on the wall which serves as a screen being reduced in quantity in direct proportion to the corresponding diminution of the aperture.

(B.) If now, in place of the wall with an opening, we have an opaque disc pierced with a hole at some distance from its centre, and if we have a light opposite this hole, we shall see, on imparting a rotatory movement to the disc, that the projected light will be displaced, and move in a circle on the screen, and a ring, uniformly lighted is formed in consequence of the image being imprinted on the retina. The luminous intensity of this ring is independent of the speed imparted to the disc. In addition to experiments various calculations of a physiological character, which we shall not now enter into, fully establish this fact.

This intensity depends only upon the size of the hole, and if, during the rotation of the disc, this size is increased or diminished, the ring will receive more or less light in proportion to the surface of the opening, as has been already said in (A).

The principles (A) and (B) being explained, we will now describe the construction of the photometer.

D, D', (fig. 1), are two discs of the same diameter placed face to face having their circumferences cut into the form of battlements; they move one on the other, so that open or closed spaces more or less large can be presented at the will of the observer.

One of these discs, D, is pivoted on an axis set in rotation by a handle, M (fig. 2), a fly-wheel and an endless cord.

The second disc, D', turns on the axis of the disc, D, and bears a cylinder with a spiral groove in which a pivot works connected with the collet C (fig. 1), which, by means of a pin or key, can move longitudinally into a second groove made in the axis of the disc, D, and worked by a generator. This collet, C, is terminated by a circular rack, worked by the pinion, P, and the button, B.

We can understand that by turning this button, the rack

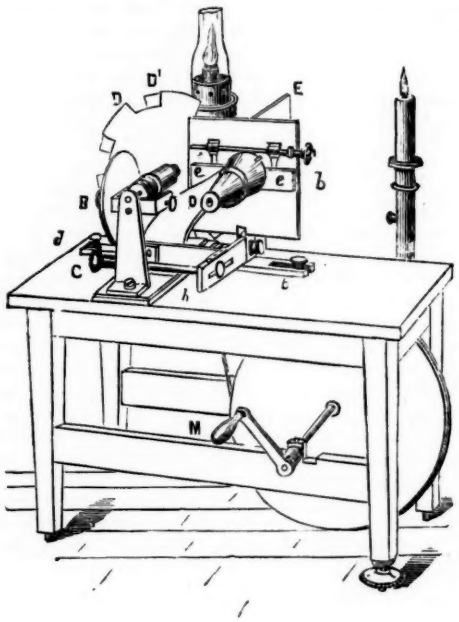


FIG. 2.

of the collet advances or retreats according to the direction of the movement, and the pivot fixed in the helical groove of the cylinder of the disc, D, forces the latter to displace itself on the disc, D', to an extent which depends on the furrow of the spiral. This furrow is so calculated that a complete movement of the collet, C, corresponds to such a movement of the discs as shall intercept all the light by completely filling up the battlements.

The battlements can be opened or closed to any extent, the discs being either in motion or at rest. At the end of the axis of the pinion, P, and near the button, B, a needle indicates on a dial divided into 180 degrees the exact extent of each opening.

At O (fig. 2), an eye-piece is placed at the top of a tube in the form of a cone, closed at the other end by a piece of ground glass. In a line with this tube, beyond the ground glass, is an opaque screen, E, intended to separate the rays emitted by the standard light from those proceeding from the light to be tested. This screen can, by means of the button, *c*, and the rack, *h*, be made to move backwards or forwards, and thus to throw the two reflections on to the ground glass, so as to furnish a measurement as convenient as exact.

A button, *b*, serves to bring together or separate the two plates, *e*, *e'*, which increase or diminish the luminous space at the will of the observer. In order to use the instrument

the two lights are placed at an equal distance from the ground glass at such an angle that the screen, E, shall bisect it. With the right hand the handle, M, is turned at the rate of about one revolution a second, which gives to the discs, D, D^1, a speed of 30 revolutions. The eye is placed at the eye-piece, O, and with the left hand, by the help of the button, B, the battlements on the discs are opened or closed, so as to obtain on the ground glass two luminous reflections of the same intensity. The rays of the standard light placed at the right are projected directly upon the ground glass; those sent out by the light to be tested passing through the battlements on the discs, come from the left.

The needle of the dial indicates the number of degrees of the sum of the openings. The ratio of this number to the circumference (360°) gives the number of units of the standard light. If, for example, the quotient is 3, 4, or 5, we conclude that the light tried is 3, 4, or 5 times as intense as the one taken as unit. It may be objected that this measurement, which depends, as with all others photometers, on the correctness of the eye of the observer, will be sometimes subject to error. Such a case may certainly present itself; but it will always be possible to correct the observations by repeating them several times, which can be done very easily and very quickly with this apparatus, as there is no necessity to displace the lights.

ELECTRIC LIGHT MEASUREMENTS.

By H. R. KEMPE.

III.

FOR making measurements of currents of from 1 up to 1,000 ampères, by the apparatus which has been described, shunts of the respective values 1, ·1, and ·01 ohms are required. As these shunts have to be traversed by powerful currents it is very necessary that they be made of as thick wire as possible, and as moreover in spite of their thickness they are liable to become heated by the passage of the currents, they must be made of a metal whose electrical resistance is as little as possible affected by heat, such, for instance, as German silver. This metal varies so greatly in its composition that it is almost impossible to state definitely what length of wire of a particular diameter is necessary to give any particular resistance. Approximately we may take the following formula for obtaining the length and diameter of a German silver wire of any particular resistance:

$$d = \sqrt{\frac{l \times 380}{R}} \quad \text{or} \quad l = \frac{d^2 R}{380}$$

where d is the diameter of the wire in *mils*,* l the length in yards, and R the resistance in ohms.

For example.—The diameter of a wire 1 yard long and having a resistance of ·1 ohm was required.

$$d = \sqrt{\frac{1 \times 380}{\cdot 1}} = 61{\cdot}6 \text{ mils} = \tfrac{1}{16}\text{th inch}$$

approximately.

A wire of this diameter would not be thick enough to resist a current of 100 ampères; about $\frac{3}{16}$th or $\frac{1}{8}$th of an inch would however answer the purpose; to obtain $\frac{1}{10}$th of an ohm resistance with such a wire its length would have to be about four or five yards.

For the 1 ohm shunt, which is required for measurements of currents of from 1 to 10 ampères, a wire $\frac{1}{16}$ of an inch thick would be sufficiently stout for the purpose. The length of such a wire would have to be about 10 yards. The ·01 ohm shunt being required to resist a current as high as 1,000 ampères would have to contain a large mass of metal. As it is somewhat difficult to accurately adjust a resistance so low as ·01 ohms, the best plan is to take 10 wires each having a resistance of ·1 ohm and to join the 10 up in multiple arc, by this means considerable accuracy can be obtained; for if there be, for example, a 1 per cent. error in two or three of the wires, the resultant error in the multiple arc combination will be considerably less than 1 per cent.

The wires should not be covered with any insulating material, in fact they should be as much exposed to the cooling effect of the air as possible. A good plan is to wind them spirally round a slab of slate, nicks being cut in the edges of the slab so as to keep the convolutions separate from each other.

A simple and effective method of adjusting the shunt resistances is to join up a battery with a Thomson reflecting galvanometer and a high resistance in the circuit, then to shunt the galvanometer by a standard 1 ohm or ·1 ohm resistance, and then having removed the standard shunt, to insert the resistance to be adjusted and regulate it till the deflection with the standard shunt is reproduced.

A Thomson reflecting galvanometer having a resistance of about 5,000 ohms will, with five Daniell cells in circuit with 10,000 ohms, give a steady deflection of 300 divisions when the galvanometer is shunted with a resistance of five ohms. By using 25 cells, the same deflection will be given with a 1 ohm shunt. Having, therefore, joined up such an arrangement and having noted the exact deflection obtained, we have merely to remove the 1 ohm standard shunt, and insert the shunt to be regulated in its place, and then to adjust the latter till the same deflection is obtained. As it is quite easy to adjust so that the deflection becomes the same within 1 division of the scale, we can practically adjust to an accuracy of $\frac{1}{300}$ or $\frac{1}{3}$ per cent., a degree of accuracy amply sufficient for all practical purposes. To adjust the $\frac{1}{10}$th shunt the standard shunt would have to be $\frac{1}{10}$ of an ohm, and to obtain 300 divisions deflection with this the resistance in the circuit would have to be reduced from 10,000 to 1,000 ohms. As it is important that the galvanometer deflection be as steady as possible, in making the tests it is advisable to increase the battery power somewhat, say to 35 or 40 cells, and to reduce the deflection to the required 300 divisions by sliding down the adjusting magnet of the galvanometer. After obtaining the required length of wire approximately, a slightly longer length may be wound on the slate slab, and the final adjustment made by filing down the diameter of the wire along a portion or the whole of its length.

(To be continued.)

* A *mil* is the $\frac{1}{1000}$th of an inch.

FIRE PRECAUTIONS AT THEATRES.—"The Home Office has communicated with the Metropolitan Board of Works asking for a report as to the actual conditions of the London theatres in respect of security from fire, and stating what additional precautions the Board think necessary to prevent loss of life in case of conflagration; also inquiring what measures the Board think it advisable to take in the matter. The communication has been referred to the Building Act Committee for consideration." We would suggest that an electrical fire alarm should be placed in each theatre, but under the charge of an official, or some reckless individual would be apt to break the glass and give a false alarm.

THE GALES.—Since the morning of the 6th inst. a succession of gales has been experienced all over the United Kingdom. The damage to life and property has been great, and all means of intercommunication more or less seriously interrupted. The West Coast of Scotland has again suffered very severely; the rivers rose to such a height that, in many instances, people had to quit their homes and seek refuge elsewhere; harbour works sustained extensive damage, and inland roads were broken up by the action of the water. From all parts reports reach us of damage done to telegraph plant by the falling of timber and the washing away of the soil from the poles by the floods. At Edinburgh a number of telephone wires came down, but fortunately without doing any harm.

THUNDERSTORM.—On Saturday, the 7th inst., a thunderstorm passed over Thurso. The thunderpeals were loud and the flashes of lightning unusually vivid. At Grogarth (Orkney), about 11 a.m., the lightning struck a farmhouse and steading. Entering the house by the chimney, it injured a young woman and a lad who were along with two others sitting round the fireside. The outhouses were also set on fire and burned to the ground.

In Memoriam.

CARL LOUIS SCHWENDLER.

ON the 6th instant, at the village of Schoeneberg, near Berlin, after a long and painful illness, died at the comparatively early age of forty-three, Carl Louis Schwendler, whose name will long be remembered in connection with Indian telegraphy. He was born on the 18th May, 1838, at Torgau, a fortified town in Prussia, where his father was a captain in a line-infantry regiment.

When a schoolboy of 15 years, he depended entirely upon the support of a poor but devotedly-loved mother. That lady had not sufficient means to offer the talented boy the education which he desired, and thus necessity forced her to choose for him the humble and less expensive profession of a builder. He was soon apprenticed, and began his practical life as a bricklayers' labourer; but it was only natural that this occupation could not suit him long; his inclination for mathematical studies soon made him desert his first attempt, and he returned to a school, preparatory for a technical academy. He nevertheless always kept an agreeable recollection of his first start, and was ready to give a jocose description of olden times, when he mixed the mortar and carried it up the scaffolding.

Schwendler entered the Berlin Technical Academy as a student in 1856, and had then full opportunity to follow his inclinations, and combine his technical studies with those at the Berlin University, and thus he had some of the best professors as his teachers—Dove, Grasshoff, Rammelsberg, Weierstrass, Wiebe, Ritter, &c., &c. But the *nervus rerum*, which unfortunately is so necessary for even the humblest life of a student, began to fail, and the limited support from home, combined with a small but hard-earned supply from private lessons, would not suffice. Schwendler had then but one hope in his despair. The Corporation of his native town had stipends for poor students. He applied for support; but alas! he was refused. Those venerable gentlemen, taking into consideration that he had already changed his career, did not consider him a promising young man to merit their support. This was a hard blow to the student and an event which he never could forget, and upon which he delighted in after life in carrying out drastic joking whenever he visited his native town.

Schwendler was thus obliged to break off his studies before passing the Academy and to take a place in an office of a well-known gas-engineer in Berlin. At this office, which was in the immediate vicinity of Messrs. Siemens and Halske's Telegraph Works, he happened to come into contact with Dr. Werner Siemens, who at once recognised Schwendler's talent.

Curiously enough he was at first put to the anvil, probably on account of his robust stature and physical strength. His superior mental powers, however, were soon detected, and he found himself in a short time in the laboratory of Dr. Werner Siemens, assisting Dr. Esselbach, Robert Sabine, and others in the redetermination of the Siemens mercury unit of electrical resistance, in which he was very instrumental. He also assisted in making determinations of the conducting power of other metals, besides investigations on the distribution of magnetism in iron bars, &c., &c.

We think about this time he had, in compliance with the military laws of Prussia, to serve his "year" as a soldier, and although the duties required of him left but little, if any, time for laboratory work, we believe we are correct in stating that he was allowed to draw his salary during the time as if he had been actually at work: an evidence at once of the kindly feeling and estimation inspired by the assistant and of the generosity of his employers.

He was in May, 1861, engaged upon experiments with the Malta-Alexandria Cable, and when the branch business of Siemens, Halske & Co., who had started as telegraph engineers some years previous in London, found it necessary to manufacture their own submarine and subterranean cables, it was Mr. C. L. Schwendler who was deputed in 1862 by the mother firm in Berlin to arrange the electrical part of the undertaking. He was chief electrician during the manufacture and laying of several cables for the French Government, and in 1863-64 was sent to the Mediterranean to lay one of these cables. A stay at Toulon was unfortunately unavoidable, as the cable had to be turned over, and this involved night work in an atmosphere strongly impregnated with the gases generated by the sewage of the good town of Toulon, in the form of floating, decomposing, and bubbling filth on the surface of the water in the harbour. Soon after leaving Toulon, Schwendler was, either at Carthagena or Oran, attacked by typhoid fever, and had to be left in the hospital in charge of a good sisterhood until his convalescence allowed of his removal, which, owing to his vigorous constitution, was not long delayed. After a somewhat adventurous voyage, during which the cable ship ran into and sank an orange boat in the Gulf of Lyons, Schwendler was landed at a town on the Gulf of Rosas, and travelled thence by easy stages home to Germany. On his recovery he returned to England and took charge of the electrical department of Messrs. Siemens cable works at Charlton, where in addition to routine work he directed his attention to several favourite subjects. In 1865 he, in conjunction with Mr. Sabine, contributed a short paper to the British Association meeting.

The following year, in the *Philosophical Magazine*, Schwendler published a valuable paper "On the most suitable Galvanometer Resistance to be employed in Testing with the Wheatstone Bridge," which subject, till then greatly neglected, he had taken great pains to investigate both experimentally and mathematically. He retained his appointment with Messrs. Siemens Brothers until 1868, when Colonel Robinson, the Director General of Telegraphs in India at that time, found it was necessary for him to have an experienced electrician in order to put uniformity into the system of Government telegraphs there. Through the good offices of his employers, Schwendler was recommended and accepted provisionally as Assistant Electrician to the Director General of Telegraphs in India early in 1868, and remained in that position as an employé of the firm of Siemens Brothers until the commencement of 1870. Highly appreciated for his integrity, ability, and amiability by the whole staff, he was offered by his chief a commanding position in the Government service as Chief Instructor of Indian Telegraphs, and acting under the instructions of the former he, soon after his arrival in India, commenced the preparation of his now well-known "Testing Instructions" for the guidance of the

staff of the Government telegraph department there, the object in view being to facilitate the introduction and thorough understanding on the part of the officials of a rational system of testing the line and the technical arrangement of the offices.

The first part of these instructions was printed and issued to the department in 1869 in the form of a book containing about 50 pages, which was well received and met with deserved consideration both within and without the department, in spite of the fact that it was far from complete in its author's opinion, having been prepared in a hurry under pressure of other work and during almost incessant travelling. The value of these "Instructions" was, however, subsequently evidenced by the fact that much of the contents was soon after quoted in professional text-books, and other telegraph administrations applied to the department for copies. These facts and the friendly encouragement received from the late Colonel Robinson induced Schwendler to elaborate his systems of testing still further, so that during the following seven years a series of such books was printed by the Government of India and issued. The spirit which animated Schwendler in this work may be best expressed in his own words in the preface to a reprint published in 1878. He says, "However much testing may become routine by continual practice, it *will* always, and *should* always, partake of something of the nature of a physical experiment, which must be conducted with a perfectly clear understanding. Then only can the tester draw the right conclusion from his observed facts, then only can testing become of real benefit to the administration."

In India, thanks to Schwendler's energy and clear headedness, combined with the hearty co-operation of the staff, these conditions have been fulfilled. Besides the performance of his official duties, Schwendler was busy with many collateral subjects of investigation, on some of which he contributed papers to the Asiatic Society, of which he was a member of council, and to the *Philosophical Magazine*. In 1870 he investigated and published, "An Arrangement for the Discharge of Long Overland Telegraph Lines," and "A Practical Method of Locating Bad Insulators in Telegraph Lines." In 1872 he published a paper, "On the Best Resistance of the Coils of any Differential Galvanometer," and another paper, "On Differential Galvanometers;" in 1874 a paper "On the General Theory of Duplex Telegraphy," and one "On Earth Currents," and in 1876 another paper "On Duplex Telegraphy."

In 1876 Schwendler received leave of absence and returned to Europe to recruit his health. While in England in 1877 he was elected a member of the Council of the Society of Telegraph Engineers and of Electricians, to which he gave his assistance until he returned to India. Early in 1877 Schwendler was requested by the Board of Directors of the East-Indian Railway Company to institute detailed inquiries into the position of electric lighting in England with a view to the illumination of the Indian railway stations. Being, however, soon convinced that the subject was very little really understood by the majority of those in whose hands it had fallen, he proposed that before a practical trial was made at any of the Indian railway stations a series of experiments should be made upon which a correct judgment might be based. The Board of Directors having sanctioned the necessary outlay, experiments were commenced at the Indian Office Stores, Belvedere Road, Lambeth. The series which Schwendler there carried out was an elaborate, and as far as his materials went, an exhaustive one, occupying him until November, 1878. Having to return to India he was unable to finish a complete report before his departure, but he prepared a *précis* which was printed and issued.

In March, 1879, Schwendler read a paper before the Asiatic Society of Calcutta on the economy, practicability, and efficiency of the electric light for certain illuminating purposes, and on the best means of its distribution; the substance of the paper being of course based upon his experiments made in London. In the same year he published a paper on a new standard of light, and then reverting to telegraphy, we find a paper "On a Method of using a Small Fraction of the Main Current provided by a Dynamo-electric Machine for Telegraphic Purposes." This idea became a favourite one with Schwendler, and as late as last year he published a paper on "Some Experiments to supply all Lines terminating at the Calcutta station with Currents tapped from a Single Dynamo-electric Machine."

Of Schwendler's most recent life and work in India we know very little. Some years since, we believe, he suffered from an attack brought on by the heat of the climate, possibly what is known as a sunstroke, which his natural vigour and robustness enabled him subsequently to disregard, if not absolutely to forget, but which possibly laid the foundation for the fatal illness which necessitated his return to Europe, and to which he at length succumbed.

Those who enjoyed the pleasure of Schwendler's personal acquaintance will not need reminding of the brightness and almost juvenile buoyancy of his spirits which endeared him to all with whom he came into contact. He was impulsive and enthusiastic in private life as well as in his profession, but whatever he undertook to do, he did with his might, carefully and conscientiously. He was not ambitious to parade his name in "Brummagem" fashion before the world, and although better informed than the majority of the profession on the subjects he directed his attention to, he had no pedantic notions in his head, and never gave himself airs which could be offensive to anybody. In the very prime of his life and of a career of usefulness he was stricken down by a painful illness, out of which he has sunk to rest leaving many a friend and not an enemy.

He was essentially a self-made man, and by his energy commanded success, but success did not disturb or damage the purity of his mind and character. Open-hearted and natural he remained from his boyhood till his last days. He did not forget his poorer friends of days long gone by and he would take the same pride in clasping hands as heartily with the workman of his earliest companionship as he would with men ranking highest in life. We have lost in Carl Louis Schwendler not only a man of science, whom we can ill spare, and who ranked with the highest in the telegraphic profession, but a man of purest character and humanity. He was interred on Monday the 9th instant, in the quiet village churchyard of Schoeneberg, near Berlin, followed by a multitude of college friends of his youth and professional admirers, bewailed by his aged mother whose mainstay he had been through life.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

LAST Saturday should have seen, according to the published announcements, the public opening of the electric light part of this Exhibition. However, we believe that with the exception of the Electric Light and Power Generator Company's system, there is not yet a single installation in actual working order, although several preliminary trials of other competitors have taken place, amongst them being the Edison, and the Electric Light Engineering Company. We cannot attach any blame to the exhibitors for the continued delay, but would rather condemn those who are responsible for the rash statements which almost daily appear in the Press; for there could have been no consideration of a practical character on the necessary amount of work to be got through before such an elaborate exhibition could be held complete, or the excuse of the Palace directors that "no International Exhibition has ever been in readiness at the time first publicly announced," would have been needless.

The delay, however, will be of real service, and we would suggest that the further necessary time be allowed for all competing systems to have everything in readiness before more puffing announcements appear respecting the public opening. Without doubt this palace, the splendid creation of the late Sir Joseph Paxton, is the edifice of all others for such a purpose. Much larger than the Palais de l'Industrie, where the finest exhibition of the kind ever beheld has recently charmed and instructed the civilised world, it is admirably adapted for showing off to the best advantage the merits of the various lamps which will be brought together; and the crowded state of the building which was so apparent in Paris will here be entirely obviated, as all will have enough room and to spare for the installation of their apparatus. It has also an immense advantage over the French Exhibition in possessing such an elegant and lofty interior, embellished as it is with magnificent works of art. All this is to the benefit of both competitors and the public, the former will have more liberty for making the most favourable arrangements, and the latter will be able more easily to judge the merits or defects in each system.

The Electric Light and Power Generator Company has received a considerable amount of praise for being so far ahead of all competitors, and the delay of the other companies might reflect adversely upon them in public notice. This, however, would be exceedingly unfair, for, letting alone the fact that most of them were dependent, or nearly so, upon their apparatus returned from Paris, we must take into consideration that the more prominent companies are full of work elsewhere, and, therefore, their installations at the Crystal Palace could necessarily command only a portion of their time, whilst the first-mentioned company being comparatively new in the field, and not, at least to our knowledge, having yet any great demands on their resources, could afford to devote nearly all their energies to their exhibit at the Palace. We do not purpose just yet to enter into this Exhibition in detail, but we may mention that on Tuesday evening the first public display of the Edison system took place, and although an accident to the engine occurred shortly after lighting up, the damage was quickly repaired and success achieved. When the remaining incandescent systems have fairly started on their way, we intend to compare their efficiency, and we have but little doubt that Mr. Edison's system will be second to none, either in light produced for horse-power expended, or durability. There are several exhibitors, we believe, having all their apparatus ready for work, but delay is occasioned by the necessary machinery provided for these by the Crystal Palace Company not yet being out of hand.

As far as electric lighting is concerned the Exhibition promises to be at least an interesting one, but on other matters appertaining to electrical science we shall reserve our judgment for a more fitting opportunity. From a scientific point of view it would have been preferable had the arrangements been made on the lines of the French organisation, but this perhaps would have been out of the question seeing that such a short interval has elapsed between the two.

RECENT WONDERS OF ELECTRICITY.

By W. H. PREECE, F.R.S.

Delivered before the Society of Arts, on Wednesday evening, 28th December, 1881.

LECTURE I.

(*Continued from page* 25.)

AT the recent Paris Exhibition, the varied applications of electricity were simply wonderful and amusing. I have no doubt we shall have a great many of them exhibited, shortly, at the Crystal Palace, where I hope some of you may be able to go before your return to school. I will now show you how this system of producing electro-magnetism can be utilised for telegraphic purposes. On the table are fixed two complete sets of telegraph instruments, very close to each other, but the set on the right hand belongs to one station, and that on the left hand to another station. You may fancy that the instrument which I touch, on the left, is in London, and that which Mr. Cordeaux touches, on the right, is in Liverpool. For every current of electricity I send from London, I do a little work in Liverpool, and that results in motion, producing sound. The mere depression of my "key" produces electro-magnetism in Liverpool which attracts a piece of iron and produces a sound. [Illustrated by working the instrument.] The battery attached to my key is in London, and the depression of my key sends on a current which arrives at Liverpool, produces magnetism and sound. By depressing the key rapidly or slowly the sounds may be made correspondingly short or long. [Illustrated.] By an arrangement of dots and dashes, the letters of the alphabet are represented, and experienced clerks can read off the sounds and translate them with astonishing rapidity. To illustrate this to you, I will ask your secretary to write down a short sentence, unknown to my assistants, which shall be sent by one of them, Mr. Cordeaux, on one instrument (supposed to be in Liverpool), and read off by Mr. Cooper on the other instrument (supposed to be in London). [The secretary then handed in a slip of paper to Mr. Preece, and the message it contained was read off by Mr. Cooper, "A merry Christmas to the juveniles."] That is the operation of telegraphy. The sounds are read off as clearly as ordinary spoken language, though mistakes are sometimes made. For instance, a party of young school girls, out for an excursion once, wished to advise their schoolmistress of their safe arrival at a certain point, and sent the message, "arrived all right;" but the schoolmistress was horror-stricken to read the message as delivered to her, which read "arrived all tight." Telegraphically, the difference between the two messages is not great, for the letter *R* is represented by a dash between two dots, while *T* is represented by a dash. Another error in transmission was where a message, "Five fathoms and four feet is ample for my wants," was delivered, "Five fat sows and four feet;" a cricketing message from Lord's, "Jack, bring up two ground men," was delivered "Jack, bring up £2 10s." And at the time that Commodore Goodenough was appointed to a station in Australia, the message received was "A commodore has been appointed good enough for the Australian colonies." The system of telegraphy I have just shown is the ordinary one-way method; but it is possible to send two messages in the opposite direction at the same time upon one wire, and this I can make clear without going into a detailed explanation, by asking Liverpool to send dashes or long sounds to me while I send dots or rapid sounds to him. [This was done.] We go still further, and send four messages in opposite directions, at the same time upon one wire, that is called quadruplex telegraphy. But the acme of telegraphy has been produced in this country by the Wheatstone automatic apparatus. I have a complete set of this apparatus before me. In it the messages are prepared by being punched with little holes (as you now see being done), and I now hold a strip of paper bearing perforations representing the alphabet, which look very much like the patterns used in the Jacquard loom for lace-making. The perforated paper is put in the transmitter, which sends currents of electricity, representing the holes upon it; these currents of electricity are received by a "receiver," by which they are made to represent dots and dashes recorded on a long slip of green paper, and these dots and dashes indicate

to the clerk at the receiving station the message sent. The peculiarity of this instrument is its rapidity, for, by it, instead of being only able to send from 30 to 40 words a minute (the limit of the human hand), from 250 to 300 words a minute can be transmitted. At the present moment there is not a town in this country where a daily paper is published that is not in direct communication with London, and receives its intelligence by means of apparatus of this description. Whatever news it is, whether an account of the Canonbury railway accident, or a panic that may have happened this afternoon in some theatre, or something else now going forward to the country papers, it is being sent by means of this perforated paper and automatic instrument. Those who are interested in the apparatus will be able to examine it closely at the end of the lecture; but it is impossible for me to describe it minutely now, because it would occupy more than one lecture to understand the whole working of the system. It is most extensively employed in this country, where the growth of telegraph business has been enormous. I spoke in rather glowing terms of the duties and doings of this automatic apparatus when in Paris, and my Parisian friends rather doubted my statement. However, I induced the French Government to send an officer over to England, to examine for themselves the working of this instrument; and to my great pleasure when he came here he found that my statements were under the mark; and only a few days ago, when an experiment was tried, to satisfy the French gentleman, we were able to transmit on a wire between London and Glasgow no less than 352 words a minute. The growth of telegraphy in this country has been enormous. In 1869 there were only 2,000 offices open, there are now 5,500; there were then only 6,000,000 messages sent a twelvemonth, there are now 30,000,000; the income in 1869 was £700,000, it is now £1,600,000; the number of newspapers and clubs supplied with news was then only 173, it is now 803; and there are 326 towns now being supplied with news direct from London. In regard to submarine cables, I have here a box of specimens of the various types of cable laid down, which is well worth examination. Submarine telegraphy has increased, during the ten years, from a few hundred miles of cable, to 70,000 miles, which now engirdles the world. There are many other applications of electricity besides telegraphy, such as, for instance, railway signals. A railway accident recently occurred at Canonbury, where three or four trains were huddled up in a tunnel. I do not know much about the system of signalling used on that railway, but I know a good deal of the system of signalling in use on the London and South-Western Railway and other lines. The principle of the "block" system is simply that a railway is supposed to be divided into certain sections of a given length, and no two trains are allowed, or ought to be allowed, to be in one section at the same time. If, for instance, the section be a tunnel, such as at Canonbury, and two trains are allowed on it, the risk of collision is great, as recently proved. But if the block system be thoroughly and efficiently carried out, there ought to be no such accidents. Some twenty years ago, after a good deal of talking, writing, and persuading, I induced the London and South-Western Railway to adopt the block system. The system in use on the London and South-Western Railway is my own. A complete set of apparatus is before you, and I will explain its working. A little semaphore is in front of the instrument, which, when down, indicates that all is clear, and when up, that there is danger, and the train must stop. Suppose the instrument near me is at Waterloo Station, and the other one near Mr. Goldstone is at Vauxhall. That represents a section of the railway upon which we want to allow one train only at a time. To ascertain if all is clear to Vauxhall, I send a warning signal of two beats given twice, indicating "A train is coming," which is acknowledged by a signal of one beat from Vauxhall; my semaphore arm is down, telling me that the line is clear, and I let the train go on, sending a signal of two beats [this was done] to Vauxhall, to tell him that the train is in. Vauxhall raises the semaphore behind the train to prevent me from sending on another, and I acknowledge his signal by giving one beat of the bell. The train is now proceeding; the semaphore arm at this end is up, protecting the train, and I cannot, I dare not, send another train until I know that the one now going on has arrived at Vauxhall. It is now supposed to have done so, and he sends three beats upon the bell, which lowers my semaphore arm and tells me "Line clear," and that the apparatus is in working order. On such a system the traffic of a railway can be conducted day by day, and hour by hour, with safety to the public, and with satisfaction and certainty to the railway interest. One other illustration that I must give you, of the application of electricity, especially as my store of energy is not yet exhausted, is the telephone. One of the most beautiful things at the Paris Exhibition was the transmission of music, by means of the telephone, from the Opera House to the Exhibition building. At the Opera House several microphones were fixed upon the stage, and at the Exhibition building telephones were fixed in rooms into which visitors could go, and, by applying the telephones to their ears, could listen to the overture of the orchestra, or the singing or talking of the performers, as also the hum of the ballet-girls behind the stage. The effect was something startling. I remember one night seeing a Frenchman put the telephones to his ears, and the moment he heard the sounds he threw down the instruments, and rushed out of the room, saying, "*C'est terrible, c'est terrible!*" The Christmas holidays have prevented my having similar arrangements for this lecture, and the best thing I could get ready is a telephone circuit between this hall and a neighbouring room. I will call up and ask my assistant to play something on a cornet. [The cornet was heard playing quite distinctly.] That is an instance of what I wished to illustrate to you at the commencement. We have a bugler, full of energy, who blows into his bugle, the energy of which takes the form of sound; the sound waves, or vibrations, strike the top of the telephone case, and set a microphone in vibration, which causes currents of electricity to pass along the wire from the instrument at the other end to the one before you. In the receiving instrument the currents sent by the microphone take the form of electro-magnetism, and reproduce the vibration of the microphone upon a disc in front of the electro-magnet, and so we get reproduced in the same form the energy set in motion at the other end, after having passed through various stages. The motion of the cornet is transferred, first, into the motion of the disc, then into the electrical form of energy, then into that of electro-magnetism, then back again into motion, and, finally, to your ears; and you will easily understand from this that electric currents are merely one form of energy. I intend to pursue this subject next time, and show you how electricity is produced in other ways, and how it breaks up chemical compounds with their separate parts; how electro-plating and silvering is done; and finally I will show how it produces the beautiful Edison electric light we now have in this room. The elegant chandelier now illuminating this room was made especially for exhibition at this lecture, and was prepared by Messrs. B. Verity and Sons, of King-street, Covent-garden.

NOTES.

CRYSTAL PALACE INTERNATIONAL ELECTRIC EXHIBITION.—With a view of giving greater interest to the awards at the recent Woollen Exhibition, the presentation of the medals to the successful exhibitors has been postponed until the Eelectric Exhibition is in full working order. It has now been arranged that these medals should be presented by the Lord Mayor on Tuesday evening, January 31. The whole of the palace, from the Brighton Railway Station to the tropical end, will be by this time completely lighted by the various systems of electric lighting.

THE PRICE OF GAS AND THE ELECTRIC LIGHT.—Owing to the strong agitation of the inhabitants and the competition of the electric light, the directors of the Barnsley Gas Company have agreed, in addition to a reduction of 5s. each for public lamps, to reduce the price from 3s. 5d. to 3s. and 2s. 6d. per 1,000 feet, according to the quantity consumed. They also recommend a material reduction of meter rents.

THE ELECTRIC LIGHT AND HORTICULTURE.—M. Deherain, Professor of the Museum of Natural History in Paris, has made a series of investigations on the action of the electric light on horticulture and agriculture, arriving at the conclusion that the electric light is capable of giving a certain impetus to vegetation when it supplements the ordinary action of solar light and heat, but it is incapable of supplying this of itself. M. Deherain concludes that the electric light produced by the voltaic arc has only a feeble and uncertain action on vegetation.

THE ELECTRIC LIGHT IN THE HOUSE OF COMMONS.—The House of Commons will, at the commencement of the Session, be illuminated by the customary means, last year's experiments with the electric light not being quite satisfactory. Palace Yard will, however, be lighted by electricity.

ELECTRIC LIGHT AT OLDHAM.—Messrs. Platt Brothers and Co., the machinists, have determined to try the electric light in the moulding and joinery portion of their premises at Werneth.

ELECTRIC LIGHT AT THE MANSION HOUSE.—At the recent juvenile ball given by the Lord Mayor and Lady Mayoress, electric lighting was introduced with great effect, the Siemens system being applied in the Egyptian Hall, while the Swan incandescent lamps illumined the lobby and other apartments.

ELECTRIC LIGHTING, &C., IN BUENOS AYRES. — The Buenos Ayres Electric Company has been formed, with a capital of £100,000, for the purpose of carrying on electric light, telegraph, and telephonic business in the Argentine Republic.

EDINBURGH TOWN COUNCIL AND THE ELECTRIC LIGHT.—At a meeting of the Edinburgh Town Council, held on Tuesday last, a letter was read from the agent of the Anglo-American Brush Electric Light Corporation, dated 27th December last, with reference to the termination of their contract with the City. The letter expressed on behalf of the directors of the Corporation "their extreme disappointment at the treatment they had received from the Lighting Committee relative to the lighting of the streets of Edinburgh, and their astonishment that the Town Council should have given so little encouragement to what is deemed to be one of the greatest agents of the day, and which may ultimately prove a great boon to the public."

The Convenor of Committee said this question had been considered from a public point of view as affecting the efficient and economic lighting of the public streets. He next read some correspondence between the agent of the Corporation and the Committee, with the view of showing that the vagueness of the offer of the Company left no other course open to them than the termination of the contract.

ELECTRIC LIGHTING.—It is probable that the president of the Local Government Board will ask the House of Commons to appoint a committee to consider the subject of electric lighting, and to refer all the bills on the subject to this committee.

STAITE AND PETRIE'S ELECTRIC LIGHT.—On Friday evening, the 10th inst., Mr. Staite had the honour of displaying before the Queen and the royal and distinguished visitors at Worsley Hall three illustrations of unparalleled splendour and power. One light of extraordinary brilliancy was erected in the flower garden on the western end of the terrace, and facing the drawing room windows. The light was inclosed in a Fresnel dioptric lens, and being somewhat elevated must have been seen for many miles around. The whole of the surrounding scenery appeared as if bathed in sunshine, and the walks and terraces were as light as day. Two other lights, furnished with suitable reflectors of great size and power, were simultaneously displayed at the two extreme ends of the front terrace, and their united rays were directed on to the fountain in the centre, which was kept playing the whole night. At intervals one of the reflectors was turned about in various directions, rendering distant objects distinctly visible, some of them miles away. The Queen was highly pleased, and took much interest in the various effects produced, particularly at the fountain, where a bow could be seen playing about, radiant with the prismatic colours. Certainly never before did such a brilliant light, or rather series of lights, shine on so brilliant a company. It is important to observe that the light was *self-sustaining*, and remained, without any kind of interference, in glaring action the whole night, until the Queen and visitors retired.—*Mechanics' Magazine*, Oct. 18th, 1851.

DANGERS OF ELECTRIC LIGHTING.—Fires caused by defective arrangements in electric light machinery are becoming too frequent to be tolerated. The electric light people try to laugh it off, but their excuses are becoming threadbare, and they must bestir themselves. The fact is that these electric light companies are imitating the telegraph companies by endeavouring to get cheap men, in whose hands the light will become as destructive as coal oil. The companies must hire trained, competent and reliable men, to obtain them they must pay good salaries. By the time some of the directors have been indicted for manslaughter they will probably realise that "cheap" men are not as profitable as skilled ones. Five deaths, a hundred fires, and any number of narrow escapes is too bad a record for the electric light in its early days.—*The Operator*.

A MILL in Philadelphia has been burnt and twelve lives were sacrificed, the fire being caused by the crossing of electric light leads.—*The Operator*.

EDISON ELECTRIC LIGHT COMPANY.—The stockholders of the Edison Electric Light Illuminating Company on Tuesday elected the following directors:—Norvin Green, S. B. Eaton, Thomas A. Edison, E. P. Fabbri, James H. Banker, Henry Villard, R. M. Gallaway, R. L. Cutting, Jr., G. P. Lowrey, J. F. de Navarro, N. G. Miller, Galvin Goddard. Another director is still to be elected, the selection of whom will be made by the Tracy R. Edson Estate.—*The Operator*.

ELECTRIC LIGHTING.—At the Aberdeen Music Hall, where a poultry and pigeon show is now being held, there are 4 Pilsen arc lamps and 20 Joel semi-incandescent in action. Ten of these latter are going to New Zealand, and there will shortly be 36 working at the Crystal Palace Exhibition. At Glasgow, in the Art Exhibition, 4 Pilsen arc lamps and 6 Joel lamps are installed.

ELECTRIC LIGHT IN HUNGARY.—We notice in the *Portefeuille du Capitaliste* of Paris, that an Electric Lighting Company has been formed in Pesth, with a capital of 600,000 florins. The objects of this company are to distribute electric light in the various towns of Hungary, and the company also intend to supply dynamo-electric machines for all purposes. The promoters have already contracted for the lighting of Ganz's works and also for the telegraph works of Neuhold.

ELECTRIC LIGHT *v.* GAS.—The Duke of Sutherland has given notice to the Gas Committee of the Stoke-on-Trent Corporation for the discontinuance of the contract for the supply of gas to Trentham Hall, with the view of adopting the electric light at his Staffordshire seat at an early date. His Grace is the largest gas consumer in Staffordshire, having at Trentham burned 80,000 to 1,000,000 cubic feet per annum for some years past, and has been supplied at 6d. per 1000 feet less than the general public.

NEW ELECTRIC COMPANY.—The following is translated from *Le Portefeuille du Capitaliste* of Paris :—"We have already announced the purchase of Gramme's French patents by a company established in Paris. The following are more or less the conditions under which the company has been formed : These patents are to serve as a basis for the foundation of a French 'Société anonyme,' with a capital of ten million francs. This company to be called the "Compagnie Electrique." The International Telephone Company takes part in the foundation of this company, to the amount of 15,000 shares of 500 francs each, of which they will offer 5,000 at par to their shareholders. The balance is to be subscribed by the syndicate who are connected with the formation of the International Telephone Company. The Gramme patents are bought without any reserve, and they will be paid for by 1,000 fully paid up shares of 500 francs each. The board of direction will consist of Messrs. Fontaine, Carimentrant, Maure, and Niaudet."

THE UNITED TELEPHONE COMPANY (LIMITED) *v.* ALEXANDER MACLEAN.—We understand this suit comes up for hearing before the Scotch Courts on the 24th inst.

THE HUNNINGS-COX-WALKER TELEPHONE.—We understand that Messrs. Elliott Brothers, Messrs. Strode and Co., and Messrs. Barraud and Lund, are now acting in London as agents for the above telephones, and that the former firm are working these instruments in preference to the Gower-Bell, which they formerly employed. Messrs. Strode employ the system between their offices in St. Paul's Churchyard, Cockspur Street, and Regent's Park. Messrs. Lund have a circuit fitted with similar apparatus between Cornhill and Pall Mall.

TELEGRAPH AND TELEPHONE WIRES.—That scientific appliances devised for the accommodation and convenience of mankind sometimes defeat their own objects was only too tragically proved the other day at Sheffield. During a fire which occurred in that town a little girl was burnt to death who could unquestionably have been rescued had not the fire-escape been unfortunately delayed in its passage along the line of route intervening between its regular station and the scene of the conflagration. It underwent no fewer than three stoppages, each involving a loss of time of one or two minutes, through encountering telegraph and telephone wires stretched from housetop to housetop across the streets. While the escape was being slanted to pass under these obstacles a house was burning furiously, and the unnecessary sacrifice of a human life was being rapidly accomplished. This lamentable incident having been brought to the notice of the Sheffield Town Council on Wednesday, that body at once resolved to take measures for raising all telegraphic wires traversing the public thoroughfares above ground to a minimum height of thirty-five feet. The municipal authorities of every provincial town within the length and breadth of the United Kingdom should bestir themselves without delay in following the salutary example set to them by the Sheffield corporation. It is the imperative duty of Local Governments to sweep away, no matter at what pecuniary cost to companies or individuals, all potential hindrances to the saving of life.—*Daily Press.*

CABLE NOTES.—The Silvertown Company received a telegram on the 14th inst. stating that the steamship *Dacia*, Mr. Wm. F. King, F.R.S.E., engineer in charge, arrived safely at Valparaiso on the 11th inst., and left for Callao (Lima) on the following day. All well on board. The telegram further stated that the steamship *Retriever*, Mr. E. W. Parsoné, engineer and manager to the West Coast of America Telegraph Company, in charge, was expected to arrive at Callao on the same day. The *Retriever* has therefore ten clear days to make the survey of the Chorillos-Payta section before joining the *Dacia*.

SELF-ACTING APPARATUS FOR THE PRESERVATION OF THEATRES IN CASE OF FIRE.—Prof. Obernien proposes the following ingenious and simple arrangement. Cords of hemp are stretched from left to right across the upper part of the entire space above the stage. They are fixed at one side and on the other they pass over pulleys, and are kept tight by means of weights which are surrounded with cases. Perpendicularly under the weights, at the bottom of the cases, is a button, which if pressed downwards closes the circuit of a powerful battery. If a flame rises up it catches and ruptures one of these threads, when the weight falls in the same moment upon the button and closes the battery. The results are :—1, a telegraphic message to the nearest station of the fire brigade ; 2, a fire-proof curtain is let down by a mechanism set in motion by a suitably arranged electro-magnet ; 3, an electro-magnet opens a large ventilator in the roof above the stage for the escape of the flames and smoke, and 4, a reservoir is opened which lays the stage under water.—*Chemiker Zeitung.*

ASBESTOS.—This substance has of late been brought prominently forward for many purposes used in engineering. Amongst others may be mentioned its utility for steam packing, stuffing boxes, glands, &c., and it makes also a useful cement mixed with other materials to resist high temperatures. It cannot be destroyed by fire, it is a non-conductor of heat, rust and acids do not affect it, and now the latest application of this material is the idea of making a fire-proof paint. Some most interesting tests have been made with the new paint. A model theatre coated all over and afterwards drenched with turpentine was set on fire

and the only damage it sustained was a charring of the lower ends of the scenes by the flames, the timbering not being even ignited. A similar model unprotected was completely consumed. A piece of wood protected by the paint was placed for half an hour in an ordinary grate, and although the wood within was reduced to charcoal, no blaze whatever was emitted during the test. This paint might probably be applied to the protection of electric light wires, which are not by any means safe, and at times may readily set fire to any wooden structure upon which they may be placed. Their insulation is oftentimes destroyed by burning, and it would seem that an application of this paint would be of considerable service in this direction as well as a protection from the deteriorating effects of the atmosphere. In fact, its utility may well be imagined for many purposes connected with electricity; the coils of dynamo machines would be greatly benefited by the coating of each layer of wire with the paint, it being scarcely probable that their insulation would then become bad, or that any short circuit should occur. Electric light engineers will have an opportunity of examining this novel use of Asbestos at the forthcoming Crystal Palace Exhibition, all the woodwork on the great stage being coated with this paint. The process belongs to the United Asbestos Company.

MEASUREMENT OF THE POTENTIALS CORRESPONDING TO DETERMINED STRIKING DISTANCES.—By M. J. B. Baille.—The electric potential of a conductor with reference to an interior point plays in the study of electricity the same part as does temperature in the study of heat. To have a scale of potentials analogous to the scale of temperatures it is necessary to refer the measurement to an apparent phenomenon easy of reproduction. I have proposed to measure the potentials of a conductor corresponding to determined spark-lengths.

My method consists in causing a spark to strike between two planes, one of which was electrified, the other, slightly convex, being on the ground. The striking distance was measured with care. The electrified conductor communicated with a sort of absolute electrometer. This was a large plane disc attracting the central part of a parallel plane connected with the ground. This central part was attached to the beam of a very sensitive balance, and the attraction was measured directly by means of weights.

The potential of the attracting plane V was given by the formula—

$$V = D\sqrt{\frac{8\pi g P}{A}}$$

in which D is the distance from the attracting disc to the movable plate of the balance, A the surface of the circle attracted, and P the weight counterpoising the attraction. The observations were very regular and gave concordant results. I have measured the potentials corresponding to striking distances varying from 1-50th of a millimetre to a centimetre. The chief difficulty consisted in bringing the electrified conductor to a constant potential during the time of weighing. I made use for that purpose of a condenser of variable capacity. I added condensers such that the spark was produced only at rather long intervals; the potential was then a maximum which was slowly reached, and the attraction likewise reached its maximum at the same time as the spark.

Sir W. Thomson has already made some similar determinations for small striking distances; the numbers which he has found are decidedly lower than those which I give for the same spark lengths. I attribute this divergence to the fact that Sir W. Thomson's conductor was constantly discharged by a continual series of sparks, so that the potential varied continually and very quickly, and it was only possible to obtain an intermediate value. According to the table given the potential of electrified plane increases regularly with the striking distances to be broken through. We may calculate the electric densities corresponding to the different spark lengths; it is seen that these densities decrease at first slowly and arrive soon at a constant value. The pressure of the electricity upon the air at the moment when a spark springs 0·01 metre is only the $\frac{1}{2000}$ part of the atmospheric pressure.—*Comptes Rendus.*

ON THE PERMANENT MAGNETISM OF STEEL AT DIFFERENT TEMPERATURES.—By G. Poloni.—The steel rods were cylindrical, and passed in a vertical direction through an induction-coil. The influence of the earth was evanescent.

In order to assume the permanent magnetism corresponding to a certain temperature, the rod requires a somewhat longer time for cooling than for heating. The greater the total decrease of the magnetism, the longer are these times. The number of the successively following heatings and coolings by which the rod is brought to a permanent condition is about proportional to the permanent decrease of the initial magnetism. The greatest loss is between 170°—200° C. Every shock effects a decrease of magnetism when the rod is hot. After repeated agitations and heatings the rod undergoes no permanent changes. The distribution of the magnetism was likewise examined in long rods, according to the methods of Van Rees. In his formula for the moment, M, at points distant x from the end $M = a\,(1 + k^{-1} - k^{-x} - k^{(l-x)})\,l\,x$, where l denotes the length of rods and a and k are constants, it appeared that under certain circumstances k is constant at all temperatures, for the same magnet, whilst a varies with the temperature. Jamin found a depend merely on the nature of the rod. Below 180° C. the distribution of the magnetism varies no longer, *i.e.*, the value of k remains constant, and the neutral line lies always in the middle of the rods. Above 180° C. the same thing takes place if the rod has been repeatedly heated before being magnetised. But if it has been magnetised before the heatings and coolings, k varies with the temperature, and the neutral line is displaced towards the north pole, so that austral magnetism extends over two-thirds of the rod.—*Wiedemann's Beiblätter.*

MR. EDISON.—On Tuesday last Mr. Thomas A. Edison took out twenty-five patents, the largest number ever issued to one person by any government in one day. He now holds 250 patents.—*Operator.*

ELECTRIC LIGHT AT MILFORD DOCKS.—On Monday night the large promenade facing the new Milford Docks was most successfully lighted up by the British Electric Light Company with one of their Gramme machines and five powerful Brockie electric lamps. The effect was pronounced by all who saw it to be most satisfactory, the light

being remarkably steady and brilliant. This lighting is the first part of a greatly extended system to be adopted in illuminating the whole town, harbour, and new pier recently erected for the accommodation of transatlantic steamers. The installation of this lighting created a great sensation in the district, and nearly the whole population turned out to witness the display.

THE CENTRAL TELEPHONE OFFICE IN PARIS.—The Paris Telephone Company have now got their new central office in the Avenue de l'Opéra into full working order, and it contains one of the most extensive and complete telephonic installations to be found (in any one office) in Europe.

Upon entering from the street what was once a shop is occupied as an office for the public, where they can get every information as to the facilities offered by the company and inspect models of every description of instrument and material used in carrying out the system; immediately behind this is situated the telephone office itself and downstairs is the commutator room and other necessary dependencies.

The wires are laid by the French state telegraph administration in the sewers; they are laid up in cables each containing seven circuits of two wires, and each pair is easily recognised by being covered with cotton of a different colour from the others; each of these cables is inclosed in lead according to the well-known French plan.

250 cables as described, furnishing 1,760 circuits, are led from the street into the underground floor of the office and are carried to six gigantic commutator boards arranged in two sets of three each; these are each of some eight feet high by six feet broad, and are of the dial or *rosasse* pattern adopted by the French telegraph administration, each *rosasse* accommodating 42 cables or 294 circuits. Each cable is numbered and its wires are led to a similarly numbered group of 14 (two for each circuit) binding screws placed on the circumference of the commutator, which are permanently connected with 14 other binding screws directly in front of them, and from which depart corresponding wires leading directly upstairs to the telephone room; each set is carefully marked with the name and office number of the subscriber using them.

In the system adopted all the outlying or district offices, of which there are eight situated in different parts of the city, communicate directly and permanently with each other by such a number of wires as correspond to their respective wants; and although these through wires are brought into the station in the Avenue de l'Opéra, they do not in any way afford communication with that office, but are carried directly to one of the large commutators we have mentioned, from where they again leave the building by corresponding sets of cables that run to the respective district offices. These commutators, although accommodating each as many as 294 circuits, or 588 arrival and as many departure wires each, are excessively simple and handy. No plugs are used, but any necessary changes are instantly effected by merely removing the wires from one binding screw to another.

Behind the commutator room is the battery room, in which are the cells used for working the call bells and the transmitting microphones that are upstairs. The Leclanché, with large bent zinc plates, is the form used;. they stand on glass tables. Each call bell has eight cells, and each microphone four, but only two of them are in service at a time, the other two resting idle to recover the effects of polarisation. The telephone office upstairs is a long room divided longitudinally by two sets of commutator boards running nearly from end to end, and placed back to back, with an interval of some three feet between them so as to allow easy access to, and free inspection of, all the connections necessary to establish the communications carried out on the front of the board. Each of these boards is divided into twenty-one panels, each of which accommodates twenty-five subscribers. The calls are arranged on the well-known American system: the number of the calling subscriber is exhibited by the current releasing a small metal flap which when down closes the circuit of a local bell; the clerk on duty puts himself in speaking communication by inserting a jack knife plug into the correspondingly numbered hole in the commutator lying immediately under the calls; having ascertained the number of the subscriber the first caller wishes to communicate with, the clerk put them into direct communication by two jack knife plugs connected by a wire, inserted in the respective numbers on the commutator. In the case of the two subscribers not being on the same group of twenty-five on the board recourse is had to a Swiss commutator, which is placed directly under each panel and by which communication is made from any one number in one group to any number in another. The two long commutators we have described as standing back to back are considered as two entirely independent stations, and any communications necessary to be established between them are carried out by telephone and a series of connecting wires as if they were miles apart. The centre group of twenty-five numbers in each board is exclusively used to make connections between the two boards; doing this is, however, avoided as much as possible by so grouping together the subscribers on the boards that their respective numbers shall be, as far as is practicable, close to the majority of those other subscribers whom they are most in the habit of calling.

The whole installation is very clearly and methodically made, every wire is easily visited, and the number of operations necessary to establish the communications are reduced to a minimum. Each group of twenty-five numbers has its call bell (a muffled one for day and a loud one for night use), telephone, microphone, and calling key. The staff on duty in this office consists of one chief, two under chiefs, and twenty-three clerks, these latter all young ladies, who are found to be very quick and most apt at this work; for night work they are replaced by five men clerks. The number of calls made per day in this office amounts at present to an average of 7,000. Naturally some of the subscribers do not sometimes make a single call in the twenty-four hours, whereas others frequently make as many as forty or fifty. There are not more than 200 to 250 calls made in the night. The company has now some 1,400 subscribers on its books, but all are not as yet provided with wires.

The station we have hurriedly described offers an excellent example of a well-organised central telephone office, and its arrangement reflects great credit on Monsieur Lartigue, the company's general manager, on Monsieur Berthon, their engineer, and on Mr. R. G. Brown, their electrician, to which latter our thanks are more especially due for his courtesy in accompanying us on our visit to the station.

CORRESPONDENCE.

VYLE'S EASILY-TESTED LIGHTNING CONDUCTORS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Protection from lightning appears at length to be receiving from electricians and the general public a little more of the serious attention and thought which it deserves and should long ago have commanded; and a free and thorough discussion of the subject in your valuable pages would probably lead to beneficial results, more especially at the present time, when the "Report of the Lightning Rod Conference" is fresh before us. A publication or re-publication of the statistics of the deaths and damage caused by lightning annually would greatly assist in drawing still more decidedly the attention of the public, and especially of those in whose charge our public buildings, churches, factories, and such like "attractive" structures may be. The letters of "B." and "C. C. Vyle," and your own note to the latter in your issue of the 7th instant, seem to form a fair starting point, and have induced me to add a few lines on the subject *pour encourager les autres*. No doubt your remark as to the little notice that need be taken of the difference between 93 and 96 per cent. of copper in a conductor, for this purpose, is practically correct, although it is perhaps open to question as to whether it proves your former statement that the makers of the conductors of the former quality are "the best." I must, however, take stronger exception to your remark that "for a two-storey country house the ordinary form of conductor is quite as easily tested as Mr. Vyle's." In the course of my business experience of some years I have fixed many conductors in buildings of this height, and latterly have been using Mr. Vyle's patented form, and I can most unhesitatingly state that there is *no comparison* between the ease with which one can go to a properly-prepared test box (of cheap construction), which is placed outside the house in an easily accessible position, at about 4 ft. from the ground, for the purpose of testing, and going on to the roof of any house and clambering up to the chimney, or conveying a ladder to the spot and ascending it for a similar purpose; and I would therefore not only agree with your remark that Mr. Vyle's patent conductors "for chimney shafts and lofty buildings are the very best form to employ," but I would add, "and for two-storey country, and all other houses also."

Yours truly,
E. COX-WALKER.

Darlington, *Jan. 9th*, 1882.

[We quite agree with Mr. Cox-Walker that a free and thorough discussion on the subject of lightning conductors, in our columns, would lead to useful results, and we shall be glad if any of our correspondents will offer remarks on the subject. With regard to Mr. Vyle's patent conductor it seems to us that in cases where a building has a large number of chimneys, spirelets, or other projecting parts, each of which should have a conductor above the roof, some difficulty would be experienced in so arranging the system that every rod *above* the roof should be tested, unless indeed each chimney, &c., had its own special testing conductor reaching down to the ground, or nearly so; this would seem to be a rather expensive arrangement; perhaps, however, Mr. Vyle may have some observations to make on this point.—EDIT. TEL. JOUR.]

TELEPHONE CIRCUITS.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—I have lately been trying some experiments with a metallic circuit for telephonic purposes to ascertain whether this system will eliminate induction, and I have come to the conclusion that unless the respective insulation of the "out" and "in" wires is perfect that practically it is a failure. A short time ago I joined up two wires in a metallic circuit; each wire was about 2¼ miles long, but ran by a different route about 400 yards apart; one wire (No. 1) was partly over house and partly under ground and ran by itself, the other (No. 2) was on the poles of the Lancashire and Yorkshire Railway along with twenty-six other working wires. With this arrangement used as a telephone circuit I anticipated that I should get no induction from the adjacent wires on No. 2. The latter wire tested perfectly, but I knew that on No. 1 there was a bad fault of some 6,000 ohms in resistance (variable with the weather).

I was astonished to hear messages passing along on the wires adjacent to No. 2, from Leeds to Manchester, which could be read, and the only way I could account for it was by reason of the leak near to the middle of wire No. 1, although this leak was at least 400 yards from wire No. 2. Had there been no leak, in all probability I should have heard no induction, but where can you get two wires running close together which from week to week shall be free from faults?

I am, yours truly,
LOUIS J. CROSSLEY.

[Our correspondent is, we think, in error in concluding that no induction should result supposing that no faults existed. The case is very similar to the following:—Let us suppose we have an induction coil (with no iron core) wound with a primary and secondary of, say, 100 ohms each; and further, let us suppose that the secondary is joined in circuit with an external wire of 100 ohms, then, according to our correspondent, since we have a metallic circuit formed by the secondary and the 100 ohms resistance, we ought to get no induced current in this circuit if we send intermittent currents through the primary; this is evidently not the case. The primary wire in this arrangement corresponds to any one of the twenty-six working wires on the L. and Y. Railway poles, and the secondary to wire No. 2, whilst the 100 ohms external resistance corresponds to wire No. 1. If we wound the 100 ohms resistance on the induction coil and alongside the wire forming the secondary circuit referred to above, then the induced currents in one wire would neutralise the induced currents in the other; this would correspond, to some extent, to the case in which both wires of the metallic telephone circuit are on the *same* poles. We say to "some extent," for unless the relative positions of the two wires forming the metallic circuit is the same with reference to the working wires which run alongside them, complete extinction of induction will not take place. This has been proved by numerous experiments made on the Postal Telegraph and other wires; for instance, conversation was carried on without difficulty on a metallic loop between Waterloo Station and Southampton, though induction was not entirely quenched. Conversation was, however, impossible when a single wire with earth at each end was used. In no case with a metallic loop was induction completely done away with, although the insulation of the entire loop was extremely high. With a looped underground line, a mile or two in length, induction was practically entirely extinguished, but on trying the experiment with two looped wires, one of which had an earth fault, the induction from the neighbouring working wires was extremely powerful, so much so indeed as to render conversation almost, if not entirely, impossible. A case of earth on an open wire circuit would obviously have the same effect.—EDIT. TEL. JOUR.]

THE UNITED TELEPHONE COMPANY, LIMITED, *v.* ALEXANDER MACLEAN, EDINBURGH.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In looking over your valuable journal of January 7 I was glad to find you had noticed this case. My object now in writing is to suggest that any person being possessed of information which may be of use on Mr. Maclean's side should communicate with his agents, Messrs. Boyd and Macdonald, 31, Princes Street, Edinburgh, as the public can have but one wish as to the way this trial shall terminate should it come into court. I am in no way interested in the case, neither do I know Mr. Maclean. As to any verdict the company may get in a Scotch court being taken as a precedent in an English court, the idea is simply absurd. I know several wealthy English firms who are quite ready to contest the validity of either the Bell or Edison patent any time the United like to commence an action, and I have good reason for supposing the time may be counted by months when we shall have free trade in both telephones and transmitters. As you justly state, it is a matter for comment that the United Company with all the legal means at their command, has not pushed to an issue some of the several cases it has threatened in England, but should try and get a

verdict by a side issue. Had Mr. Maclean's case come on for trial in London in the hands of counsel instructed by a firm of London solicitors who I could name, and who had the getting up of the evidence for the defence in a threatened action by the United against a wealthy English firm, but unfortunately it was as usual "withdrawn by the United," I should not for one moment fear the result. Hoping you may find space in your next issue for this hurriedly written letter, I remain, yours faithfully,

ANTI-HUMBUG.

G. W. S.—Your working out is correct so far as it goes. There is a misprint in Mr. Kempe's book : c_2, which is the current flowing through the galvanometer, has been misprinted in equation [4] as c_3; this misprint occurs also on pages 104 and 105. The current is shown correctly as c_2 in fig. 28.

NEW PATENTS—1882.

129. "An improved method and apparatus for electrically lighting railway trains." W. H. PREECE and J. JAMES. Dated January 10.

130. "Improvements in machinery and apparatus for obtaining, transmitting, and applying electric currents for electric lighting, motive power, and other useful purposes." W. T. HENLEY. Dated January 10.

142. "Improvements in and applicable to the manufacture of iron and steel wire and in apparatus and appliances therefor." G. and E. WOODS. Dated January 11.

144. "Secondary galvanic batteries." H. J. HADDAN. (Communicated by E. Boettcher.) Dated January 11.

157. "Apparatus for electric lighting." G. HAWKES. Dated Jan. 11.

169. "Improvements in electro-motors and dynamo-electric machines, also in mechanism employed therein." H. S. RAISON. Dated Jan. 12.

185. "Electric accumulators." H. J. HADDAN. (Communicated by A. Morel.) Dated Jan. 13.

195. "Apparatus employed in working wire ropes, telegraph cables, and chain cables." G. CRADOCK and GOODER. Dated Jan. 13.

197. "Apparatus for the transmission and reception of sounds." W. C. BARNEY. Dated Jan. 13.

216. "An improved apparatus for preventing the fouling of anchor chains and telegraph or other cables connected to or on board lightships when swinging with the tide, or under any other circumstances, and to enable anchor mooring, cable, or telegraph cable to be cleared from each other on board." J. COCKSHOLT and H. M. GOODMAN. Dated Jan. 16.

224. "Electric lighting apparatus and methods of and means for, manufacturing parts of the same. W. R. LAKE. (Communicated by J. S. Williams.) Dated Jan. 16.

229. "Improved apparatus for tempering wire made from 'Bessemer' or 'Omer' steel." H. CARTER. Dated Jan. 17.

231. "Telephone conductors." C. W. SIEMENS. (Communicated by F. Jacob.) Dated Jan. 17.

232. "An improved permanent-way for electric and telephonic conductors." H. R. MEYER. Dated Jan. 17.

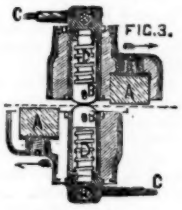
234. "Dynamo-electric machines." W. R. LAKE. (Communicated by C. A. Hussey and A. S. Dodd.) Dated Jan. 17.

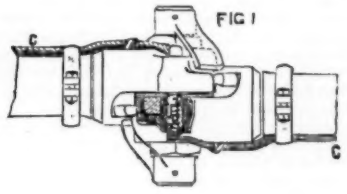
245. "Apparatus for regulating electric currents." W. R. LAKE. (Communicated by A. de Khotinsky.) Dated Jan. 17.

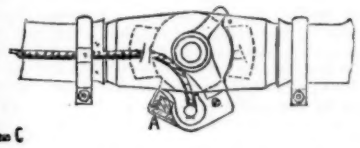
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

2215. "Couplings for electrical conductors." P. R. ALLEN. Dated May 20. 6d. Has for object improvements in couplings for electrical conductors, used as conductors of electricity for intercommunication or electric illumination or other purposes in railway trains.

Figs. 1 and 2 are an elevation and plan respectively of an electrical connection with the Westinghouse brake coupling, and figs. 3 and 4 are detail views to a larger scale of the same. In this arrangement the electrical contact is made by a pair of plungers, B, B, which are in connection with the conductors, c, c, extending along the train, and which, when the brake couplings are locked in place, the plungers are pressed hard together by means of spiral springs, D. With each half of the brake coupling there is one of these plungers, and also a piece of cleaning or scouring material, A. In the act of locking the brake coupling together each half turns a portion of a revolution on the other, as is well understood, and the plungers, B, B, before coming into contact, are thus caused to pass over the cleaning or scouring material, A, A, and thus the dirt, tarnish, oxide, &c., are removed, and a good electrical connection insured. The cleaning or scouring material may be of any desired nature, such as a mixture of emery and india-rubber, pumice stone, emery, glass or sand paper, or may be a roughened metallic file-like surface. Where necessary, a fibrous substance or form of brush may also be used in connection with the cleaning material, so that after the plunger has passed over the cleaning material it will come in contact with the fibre or brush, and have any loose particles of dirt or metallic dust removed; but with ordinary currents of electricity the passage over the cleaning material will be enough. The contact pieces and cleaning surfaces

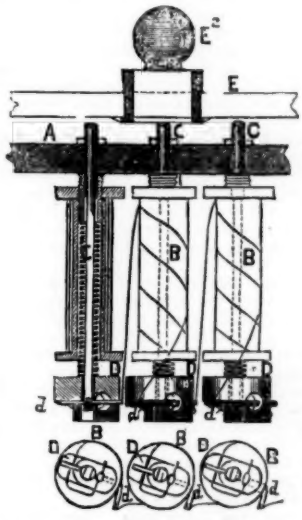






may be disposed in various ways either in the interior or exterior of the brake coupling. The brake couplings may be fitted with either one or more electrical connections of this kind, so that contact between portions of either one or more electrical conductors on a train may be made in this manner.

2263. "Apparatus for effecting electrical measurements." J. C. CUFF. Relates to "resistance boxes," the object being to render these boxes more easy to use, to increase their efficiency and durability, and by simplifying their construction to reduce greatly their cost of manufacture. The chief feature in this invention consists in a peculiar form of sliding contact which is used in the place of the ordinary plugs. The arrangement is shown by the figure. The maintenance of the contact of the coil with the pin, *d*, is obtained by means of a



coiled spring, *b*, introduced into the bobbin, as shown, which spring bears against the block, D, and thus causes it to press the wire in its groove tightly against the pin, *d*; a counter pressure on the block will provide for the facile release of the wire, or for its introduction into the transverse groove, a little play in the pinhole of the block being provided for that purpose. The pin is also connected by means of solder to the wire of the next adjacent bobbin of the row, and it is by this means that all the bobbins of each of four rows are connected together.

CITY NOTES.

Old Broad Street, January 18th, 1882.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

THE ordinary general meeting of the shareholders in this Company was held at the offices, No. 61, Old Broad Street, on Wednesday, Mr. T. Hughes, Q.C., presiding.

Mr. J. Scott, the secretary, having read the notice convening the meeting, the report (see TELEGRAPHIC JOURNAL, last issue) and accounts were taken as read.

The chairman said: Gentlemen, I have now to move that the report and accounts be read and adopted. The shareholders will see that the past half-year has been a satisfactory one, and that while the expenses have remained almost at the amount at which they

stood in the corresponding period of last year, the receipts have increased by upwards of £1,000. That is a very satisfactory state of affairs, and the shareholders, I think, may be congratulated upon the result which has been obtained. The proposal of the directors is that a dividend shall be declared at the rate of six per cent. on the ordinary shares, and of ten per cent. upon the preference shares. The only point on which I think any remarks need be made as to the accounts, is with reference to the sum of £2,000 as the annual payment on account of the Cienfuegos-Santiago Cable. The shareholders will remember the arrangement under which we bought an entirely new cable, which has been working admirably ever since it was laid, for this yearly payment. The board have considered that the payment may fairly be reckoned in estimating what amount should be carried to the reserve fund. Hitherto it has been our custom to recommend that a much larger sum than £1,000 in the half-year should be carried to the reserve. In fact, I think we have on the average carried as much as £2,500 to the reserve fund. At present the proposal of the directors is that we should carry this half-year £1,000 to the reserve, but they feel that the annual payment of £2,000 is quite a prudent recommendation and that the reserve fund is practically strengthened by the existence of the cable for which we are paying by instalments. I have nothing further to add in respect of the recent business, but I cannot pass in entire silence over the public announcement which has lately been made in the press. On the 12th January it was published in the *Standard*, and I believe also in other papers, that the American scheme of Mr. Jay Gould for laying new cables down the West Coast of America and also to Brazil, touching the Bermudas, has practically at last come to a head. I may say that the statement is that the commissions have been obtained and that contracts have been put out for the cables. Of course it remains to be seen whether it is true, and supposing it is, and that these lines are successfully laid, the position of our Company will be clearly affected by it. I alluded to the rumour two years ago, and now it appears to have taken a much more solid shape. The board think it right that the attention of the shareholders should be called to this public announcement, as to the effect of which upon their property they themselves would be quite competent to judge. The cables are in thoroughly good working order, and everything is going on in a satisfactory way. In conclusion the chairman moved the adoption of the report and accounts. (Applause.)

Mr. J. De Mancha seconded the motion.

Mr. Griffiths said, he considered that the shareholders were indebted to the chairman for the clearness of his statement and for taking the meeting into his confidence respecting the Jay Gould Cable. He had done so in times past, and it must tend to increase the good feeling between the board and the shareholders generally when they found themselves thus kept *au fait* with the latest information. The Articles of Association which regulated the relations of the shareholders and the board defined the rights of the former, and laid down rules according to which their audit was to be made. Article 12 stated, "That in every report of the auditors they shall state whether the balance sheet is a fair and full balance sheet, containing all the particulars required for the regulations, and properly drawn up so as to exhibit a full and correct view of the state of the Company's affairs." He did not intend to impugn the correctness of the accounts; but he thought it would be more in accordance with the Articles if their auditor were to follow the words of the Article, and certify the fact as required thereby. He now simply certified that they were audited and found in accordance with books and vouchers. That omitted several items required by article 120. Personally, he believed the accounts were correct; but such a slip should not take place. He would suggest that in future there should be two auditors instead of one; that would tend to increase the confidence of all who had anything to do with these matters.

The Chairman said it was perfectly open to the shareholders, and the directors would agree to it if the shareholders wished it, to appoint another auditor. Mr. Cowan had served them from the first, and the board had every reason to believe he had served thom faithfully and admirably, but it was entirely a matter for the shareholders if they wish to appoint a second auditor. It could not however, he thought, be done at that meeting. He did not know of another company that furnished their shareholders with so detailed a statement of accounts as they always furnished theirs with. (Applause.) With regard to the auditor's certificate he did not think there was much in the objection. With such accounts as they had he did not think anything more could possibly be required.

Mr. Newton thought that some reference as to the accounts should come from that side of the table. They appreciated fully the manner in which they were set forth. As the chairman had said, there was no telegraph company in existence that published as complete and full details of its traffic and its income and expenditure. Shareholders in that room who were shareholders in any other company knew that to be the fact. They ought to be thankful to the directors and the auditor, if he had anything to do with it, for issuing such an elaborate document as their balance-sheet was. But he did think that the auditor's remuneration was somewhat excessive, namely forty guineas a year.

The Secretary said it was 21 guineas for the whole of the year.

Mr. Newton expressed himself as satisfied with the accounts.

The resolution was then put and agreed to unanimously.

The Chairman then moved that a dividend at the rate of 10 per cent. be declared upon the preference shares of the Company, and a dividend at the rate of 6 per cent. free of income tax be paid on the ordinary shares of the Company.

Mr. De Mancha seconded the motion, which was agreed to.

Mr. Griffiths, in moving a vote of thanks to the chairman and directors, said he did not agree with the chairman that the report of the auditor was sufficient, because it was not in accordance with their Articles of Association. If the auditor did not follow the articles he should bring forward the subject at the next meeting. Still, to turn to more pleasing matters, their dividend was good, and the shareholders acknowledged that the chairman and directors had done their best for a long time past, and that they were well acquainted with the management of the Company and were working it most successfully. (Applause.)

Mr. Newton seconded the motion and said with reference to the proposed new cable that he thought too much impression was produced in this country by Jay Gould's operations.

The resolution was then passed unanimously.

The Chairman having replied, the proceedings terminated.

GERMAN UNION TELEGRAPH COMPANY OF BERLIN.—Notice to shareholders.—In consequence of a number of Shareholders having applied for an extension of the term to avail themselves of the right of claiming the preference shares to be issued, the term of application for the certificate is extended to the 15th of February next. The certificates issued by the direction must be presented on or before the 20th of February at the banking-house of Messrs. Emile Erlanger & Co., 43, Lothbury, London, where they will be exchanged for the corresponding number of preference shares to which the parties presenting them are entitled upon payment of the sum of £15 sterling in respect of each share subscribed for.

After the 20th of February all rights to the new preference shares on the ground of the certificates of the direction become absolutely extinct.

TELEGRAPHIC COMMUNICATION WITH THE EAST.—Owing to a breakage of the Lowestoft-Norderney cable, belonging to the Post Office, the direct wire of the Indo-European Telegraph Company between this country and India and beyond is interrupted between England and Germany. The Indo-European line is working as usual between the Continent and India. It is hardly probable that this interruption can be laid to the charge of the weather. It is to be hoped that neither the *Lady Carmichael*, of the Submarine Telegraph Company, nor the *Storm Cock*, of the Telegraph Construction and Maintenance Company, have been so unfortunate as to cause this interruption whilst at work trying to repair respectively the Zandvoort Cable and the German Union Cable, both of which cables have been interrupted.

WE are informed that the S.S. *Morna*, which is at present chartered by the Post Office for the repair of their cables, is expected to arrive in the Thames on Saturday next, having got through a considerable amount of work since leaving Silvertown in December last.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Jan. 18.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9½- 10	9⅞
		Do. Do.	10	22 - 23	22⅝
150,000	1	Electric Light and Power Generator Co.	1	1¼- 1⅜	1⅛-1 5/16
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	49½- 50	49⅝
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	76½- 77½	
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	21 - 21½	
130,000	10	Brazilian Submarine, Limited	10	11½- 11⅝	
16,000	10	Cuba, Limited	10	9½- 10	
6,000	10	Do. 10 per cent. Preference	10	16½- 17½	
13,000	10	Direct Spanish, Limited	9	4½- 5½	
6,000	10	Do. 10 per cent. Preference	10	14½ 15½	
65,000	20	Direct United States Cable, Limited, 1877	20	10½- 10⅝	10⅝
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10 - 10⅛	10⅛ xd.
70,000	10	Do. 6 per cent. Preference	10	12¼- 12⅝	xd.
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	105 -108	
199,750	10	Eastern Extension, Australasia & China, Limited	10	10½- 11⅛	11 xd.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	103	109 -112	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	104
254,300*l.*	100	{ Eastern and South African Limited 5 per cent. } { Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	101 -104	103½
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10½	9⅝ xd.
163,390	10	Globe Telegraph and Trust, Limited	10	6½- 6⅝	6⅝ xd.
163,209	10	Do. 6 per cent. Preference	10	12½- 12⅝	12½
125,000	10	Great Northern	10	11½- 12	
100,000*l.*	100	Do. 5 per cent. Debentures	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	25½- 26½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	104 -108	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4⅜- 5½	
12,060	10	Mediterranean Extension, Limited	10	2⅜- 2⅝	
8,200	10	Do. 8 per cent. Preference	10	9⅜- 9⅞	
9,000	8	Reuter's, Limited	8	12⅜- 12⅝	
280,000	Stk.	Submarine	100	235 -236	
58,225	1	Do. Scrip	1	2⅛- 2⅜	
4,200	Cert.	Submarine Cables Trust	100	97 -100	
37,350	12	Telegraph Construction and Maintenance	12	28½- 29½	29¼
150,000	100	Do. 6 per cent, Bonds, 1884	100	101 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛- 1⅜	
30,000	10	West Coast of America, Limited	10	4⅜- 5	
69,910	20	Western and Brazilian, Limited	20	7⅞- 8	7 1/16-15/16
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	110 -115	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	99 -103	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building)Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	104 -107	
88,321	10	West India and Panama, Limited	10	1⅞- 2⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	7⅞- 8⅛	8.7⅛
4,669	10	Do. 6 do. 2nd do.	10	6⅜- 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅜- 1⅝	
200,000	1	Oriental Telephone Co.	½	⅜- ½	
100,000	5	United Telephone Co.	5	12¼-12⅜	11⅜.12. 11⅝.12. 11⅜.12⅛

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited, January 6th, £2,366, January 13th, £2,462, each after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.